Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Barbara A. Lee, Director
8800 Cal Center Drive
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Governor

October 15, 2018

Mr. Peter Zorba
NASA
5800 Woolsey Canyon Road
Canoga Park, California 91304

NASA GROUNDWATER RFI REPORT, SANTA SUSANA FIELD LABORATORY, VENTURA COUNTY, CALIFORNIA

Dear Mr. Zorba:

The Department of Toxic Substances Control (DTSC) has completed its review of the draft NASA Groundwater RFI Report for the Santa Susana Field Laboratory (NASA, May 2017).

The draft NASA Groundwater RFI Report was submitted as five documents; a summary report volume (Volume 1) with the following four appendices presenting investigation results for NASA's areas of impacted groundwater (AIGs):

- Former LOX Plant AIG Data Evaluation Report (Volume 2, Appendix A);
- B204/ELV AIG Data Evaluation Report (Volume 3, Appendix B);
- Alfa/Bravo AIG Data Evaluation (Volume 4, Appendix C); and
- Coca/Delta AIG Data Evaluation (Volume 5, Appendix D).

DTSC previously reviewed and submitted comments to NASA on the Data Evaluation Reports for the Former LOX Plant AIG (comments sent April 24, 2018), the B204/ELV AIG (comments sent June 22, 2018), and the Alfa/Bravo AIG (comments sent July 19, 2018.)

Attached are DTSC's comments on the two remaining Reports, the Coca/Delta AIG Data Evaluation Report (Volume 5, Appendix D) and the summary report (Volume 1).

Please review the comments and begin preparing responses. DTSC's would like to meet with NASA by November 11, 2018 to discuss the comments and to plan the development of the final Report(s).

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If you have any questions, please contact me at Roger.Paulson@dtsc.ca.gov or at (916) 255-3702.

Sincerely,

Roger Paulson, PE, Chief
Santa Susana Field Laboratory Unit
Department of Toxic Substances Control

Attachments: *GSU Memo - Draft Volume 1, NASA Groundwater RFI Report*
GSU Memo – Draft Volume 5, Appendix D, Coca/Delta AIG Data Evaluation Report

cc: (via e-mail)

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MEMORANDUM

TO: Roger Paulson P.E., Chief
Santa Susana Field Laboratory Unit
Site Mitigation and Restoration Program

FROM: Thomas Seckington, P.G. 6460, C.HG. 739
Senior Engineering Geologist, Geological Services Unit
Geologic Services Branch
Site Mitigation and Restoration Program

PROFESSIONAL GEOLOGIST
Thomas Micheal Seckington
No. 6460
STATE OF CALIFORNIA

DATE: October 11, 2018

SUBJECT: **DRAFT VOLUME 1, NASA GROUNDWATER RFI REPORT SANTA SUSANA FIELD LABORATORY, MAY 2017**

Project: 900274-48 Activity: 22120

The Department of Toxic Substances Control (DTSC) Geologic Services Unit (GSU) reviewed and developed the following comments on the *Draft Volume 1, Draft Volume 1, NASA Groundwater Report* (Report, May 2017), prepared for the National Aeronautics and Space Administration (NASA).

The stated objectives of the Report are to summarize site histories and relevant site investigations, present the site conceptual model (SCM) for the Areas of Impacted Groundwater (AIGs) at Santa Susana Field Laboratory (SSFL) and support the Corrective Measures Study (CMS).

The Report is one of five documents that make up the NASA Groundwater RFI Report for SSFL (May 2017). The structure of the Groundwater RFI Report submittal includes five volumes: made up of a summary report (Volume 1) and the following four AIG reports:

- Former Liquid Oxygen (LOX) Plant AIG (Volume 2, Appendix A);
- Building 204/Expendable Launch Vehicle (B204/ELV) AIG (Volume 3, Appendix B);
- Alfa/Bravo AIG (Volume 4, Appendix C); and
- Coca/Delta AIG (Volume 5, Appendix D).

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This memorandum provides GSU comments on the Report (Volume 1). Review of Volume 5 is ongoing and comments on that volume will be submitted to NASA under a separate cover. GSU comments on Volume 2 were completed and submitted on April 24, 2018. GSU comments on Volume 3 were completed and submitted on June 22, 2018. GSU comments on Volume 4 were completed and submitted on July 18, 2018

If you have any questions or need additional information, please contact me at: (714) 484-5424 or Tom.Seckington@dtsc.ca.gov.

Volume 1 presents a summary of the results presented in AIG reports (Volumes 2, 3, 4, and 5). As a result, DTSC comments submitted for the AIG reports also need to be addressed and incorporated in Volume 1, where appropriate.

The following comments may be duplicative or relate to comments for the other AIG reports.

Horizontal and Vertical Delineation of Plumes

As stated in previous comments, the delineation of some of the contaminant plumes will need further resolution requiring additional data. Furthermore, an evaluation of the nature and extent of many constituents of concern (COCs), most notably metals, were not presented in the AIG reports (see comments in for AIG reports) and need to be included in the respective AIG reports and Volume 1.

Plume Stability Assessment

The GSU does not believe that there is sufficient data to support the conclusions that individual plumes are generally stable or shrinking. Comments regarding natural attenuation raised by DTSC in the 2009 Draft Groundwater RFI report have not been adequately addressed in the AIG reports or Volume 1. The GSU acknowledges that several processes such as: matrix diffusion, dispersion, adsorption, biotic degradation, and abiotic degradation are likely working at the site; however, the cumulative effect of these processes is unclear, in part, for the following reasons:

- There is a correlation between the increasing chemical concentrations and increasing groundwater elevations at the site. Given the prevailing drought conditions present in Southern California over the last decade, lower chemical concentrations trends, where present, over the same period should be viewed with caution. It should be noted that decreasing trends, as presented in the reports, are not consistent across the site. Several wells show either no trend or increasing trends. Conclusions in AIG reports and Volume 1 are sometimes too generalized to be useful. Further evaluation of the data, focused on individual wells or limited areas, should be performed to assess spatial

variability and to determine the appropriate remedial approaches for plume-scaled areas.

- The compound specific isotope analysis (CSIA) indicates some degradation from tricholorethene to cis-1,2 dicholoethene (although the lack of ^{13}C enrichment in the cis-1,2 dicholoethene may indicate further degradation) but a thorough CSIA evaluation for each plume (with appropriate temporal and spatial sampling design) has not been conducted and may be needed to better assess the stability of the plumes.
- The detection of vinyl chloride, ethenes, and various microbes are presented as evidence of chemical degradation. Although these are indications of the natural degradation of chemicals, their presence does not provide insight into the magnitude and rate of degradation. Additional evaluation of the data will need to be completed.
- The presence of recalcitrant chemicals, such as 1,4-dioxane, are not directly evaluated in the AIGs and may not behave similarly to their degradation processes and rates of the more ubiquitous VOCs at the site. Volume 1 and the AIG reports will need to acknowledge that the degradation of the contaminants other than VOCs need to be considered during remedy selections and implementation.

Faults Continuity Across Areas

Conclusions regarding several faults in the AIG reports and Volume 1 are limited to the fault segment(s) within the AIG. Variability in hydraulic characteristic over the length of the faults has been demonstrated at the site. The overall RFI Groundwater Report (for Areas I through IV, and Northern and Southern Buffer Zones) must address the behavior and variability of all the faults identified on the site.

Reviewed by: Jon Buckalew (Buck) King, P.G., C.HG.

Department of Toxic Substances Control

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MEMORANDUM

TO: Roger Paulson P.E., Chief
Santa Susana Field Laboratory Unit
Brownfields and Environmental Restoration Program

FROM: Thomas Seckington, P.G. 6460, C.HG. 739
Senior Engineering Geologist, Geological Services Unit
Geologic Services Branch
Site Mitigation and Restoration Program

PROFESSIONAL GEOLOGIST
Thomas Micheal Seckington
No. 6460
STATE OF CALIFORNIA

DATE: October 10, 2018

SUBJECT: DRAFT VOLUME 5, APPENDIX D, COCA/DELTA AIG DATA EVALUATION REPORT SANTA SUSANA FIELD LABORATORY, MAY 2017

Project: 900274-48 Activity: 22120

The Department of Toxic Substances Control (DTSC) Geologic Services Unit (GSU) reviewed and developed the following comments on the *Draft Volume 5, Appendix D, Coca/Delta AIG Data Evaluation Report* (Coca/Delta Report, May 2017), prepared for the National Aeronautics and Space Administration (NASA).

The stated objectives of the Coca/Delta Report are to summarize site histories and relevant site investigations and present the site conceptual model (SCM) for Coca/Delta Area of Impacted Groundwater (AIG) at Santa Susana Field Laboratory (SSFL). The Coca/Delta Report presents geologic and hydrogeologic interpretations and evaluates the nature and extent and fate and transport of chemicals of concern (COCs) in saturated and unsaturated bedrock at the Coca/Delta AIG.

The Coca/Delta Report is one of five documents that make up the NASA Groundwater RFI Report for SSFL (May 2017). The structure of the Groundwater RFI Report submittal includes five volumes: made up of a summary report (Volume 1) and four AIG reports:

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- Former Liquid Oxygen (LOX) Plant AIG (Volume 2, Appendix A);
- Building 204/Expendable Launch Vehicle (B204/ELV) AIG (Volume 3, Appendix B);
- Alfa/Bravo AIG (Volume 4, Appendix C); and
- Coca/Delta AIG (Volume 5, Appendix D).

This memorandum provides GSU comments on the Coca/Delta AIG (Volume 5, Appendix D). Review of Volume 1 is ongoing and comments on this volume will be submitted to NASA under a separate cover. GSU comments on Volume 2 were completed and submitted on April 24, 2018. GSU comments on Volume 3 were completed and submitted on June 22, 2018. GSU comments on Volume 4 were completed and submitted on July 18, 2018

If you have any questions or need additional information, please contact me at: (714) 484-5424 or tom.seckington@dtsc.ca.gov.

GENERAL COMMENTS

1. Alternate groundwater flow interpretations at the site may need to be considered. Figure 2-26a (Near-surface Groundwater Elevations, January 2012), Figure 2-29 (Chatsworth Formation Groundwater Elevation Contour Map, Fall 2015), and Figure 2-30 (Baseline Groundwater Sampling Piper Diagram) were reviewed and the following observations were made:

    a. Monitoring wells RD-42 and RD-79 should be depicted on Figure 2-26a not Figure 2-29. The groundwater elevations are consistent with the near-surface groundwater elevations within the Coca drainage and not consistent with general chemistry of other Chatsworth monitoring wells. The water quality from the other near-surface monitoring wells was not presented on Figure 2-30 so a comparison of water quality with the other near-surface wells was not possible. The GSU recommends that PZ-017B, PZ-045, PZ-047, PZ-048, and PZ-126 be sampled for general water chemistry, if it has not occurred previously, and the results presented on Figure 2-30.
    b. Groundwater elevations from wells WS-08, WS-11, ND-113 should not be used to determine the groundwater flow directions. Each well has very long and deep open intervals and likely reflect significant downward vertical gradients. These three wells provide the basis for the northward flow on the north side of the Coca drainage which may not be accurate.
    c. Groundwater flow across the Upper and Lower Bravo Bed needs further evaluation. The groundwater gradient for the groundwater between the Bravo Beds and Shale 2 Member (in the Alfa/Bravo area) is essentially flat, whereas the groundwater below the Bravo Bed flows significantly towards the south and Burro Flats Fault. There may be compartmentalization of groundwater due to the presence of the Bravo Beds or Coca Fault in the

Coca/Delta area.

As a result, the presence and position of the Bravo Beds, especially the Upper Bravo Bed, is important as the Coca/Delta report indicates "*The extent of the plume to the north-northwest is likely limited by the presence of the less permeable Lower Bravo Bed, as similar fine-grained layers at other Area II AIGs appear to have acted as barriers to COC migration (NASA, 2017f, 2017g).*" Since the Upper Bravo Bed crosses the Coca Fault with no apparent offset, the GSU believes it may not be correctly located south of the Coca Fault. The geologic mapping in the area west of the Coca Skim Pond should be reviewed and the location of the Bravo Beds and Coca Faults in this area should be verified.

It should be noted that Appendix E Technical Memorandum – Field Mapping, Santa Susana Field Laboratory, Ventura County, California does not appear to have addressed this area specifically. Further, Figure 6 Page-7, in the technical memorandum, has the Upper Bravo Bed (as mapped) labeled "Kcub" (it is assumed that this stands for the Cretaceous, Chatsworth Formation, Upper Bravo Bed although the legend indicates that it should be "Kucs-ubb") north of the Coca Fault and "Kcs" ("Sandstone" based on the legend) south of the Coca Fault. This apparent discrepancy should be corrected in the Coca/Delta report

2. This comment focuses specifically on the trichloroethene (TCE) plumes but the interpretation of the extent of the contaminant plume(s) is similar and applicable to the other contaminants (i.e. cis-1,2-Dichloroethene, vinyl chloride, 1,4-dioxane, 1,2,3-trichloropropane, etc.) and this comment generally applies to the interpretations and depictions of other contaminants in the document.

   Figures 2-41, 2-47, 2-48, and 2-49 depict the TCE groundwater in plan view and in various cross-sectional views. The plumes depicted, especially Figure 2-41, do not differentiate between perched groundwater and the Chatsworth formation groundwater (CFOU). The GSU recommends that the data from the perched wells be presented in a separate plan view figure for each contaminant.

   Figures 2-41 and 2-48 depict the TCE plume as truncated at the Administrative boundary between NASA-Administrated and Boeing-Administrated properties with a query mark. The GSU recommends that the concentration gradient be interpolated with the data outside the NASA-Administrative boundary.

   The TCE plumes, as shown on Figures 2-41, 2-47, 2-48, and 2-49, will likely need additional data to better constrain and refine both the lateral and vertical extents of each contaminant plume. The amount of additional data and refinement needed will be dependent on the needs for the implementation of the selected groundwater

remedy(ies).

3. The nature of the Coca Fault, Delta Structure/Fault, Skyline Fault, and Burro Flats Fault and their effects on groundwater flow and contaminant transport remains uncertain, to the extent that additional work may be needed. Specifically, aquifer test data are not available to estimate the hydraulic characteristics of the faults. The aquifer test conducted at the Coca/Delta AIG and presented in Appendix A-7, did not provide substantial data and insight regarding the faults beyond indications there was higher conductivity along a small segment of the Coca Fault. The amount of additional data and refinement needed will be dependent on the data needs for the effective design and implementation of the selected groundwater remedy(ies).

4. In section 1.4 Groundwater Chemicals of Concern, the Coca/Delta Report states that the "groundwater COCs within the Coca/Delta AIG were established in the draft Site-wide Groundwater RI Report (MHW, 2009), Appendix 7-A." The COCs established were TCE, cis-1-2-DCE, trans-1,2-DCE, 1,1-DCE, vinyl chloride, carbon tetrachloride, NDMA and 1-4-dioxane and did not include any metals. DTSC did not approve the draft Site-wide Groundwater RI or any appendices include within. DTSC's December 2011 letter and comment on draft 2009 Site-wide Groundwater RI Report, stated:

   "There is insufficient characterization of release locations to determine if these areas can and/or should be remediated. In general, the nature and extent of groundwater contamination from individual release locations/source areas have not been completed to allow for an adequate assessment of remedial alternatives."

   On March 19, 2012, Boeing, on behalf of NASA and DOE, proposed an approach on for completing the SSFL groundwater characterization which included, along other elements, "source zone characterization". This was assumed to include the complete evaluation of all COCs in soil and bedrock.

   It should be noted that the Group 4 – Southern Portion of Area II RCRA Facility Investigation Report, Santa Susana Field Laboratory prepared by MWH for NASA and dated August 2007 indicated (Table 3-2) that TPH, SVOCs, PCBs, perchlorate, metals, hydrazine, and fluoride were the COCs associated with this AIG. The Coca/Delta Report does not present any evaluation of the potential impacts of these COCs. A comprehensive evaluation of all COCs must be completed and documented in RFI for each release/source area.

Specific Comments

1. Figure 1-6: Coca Area Estimated Soil Remediation Areas

   Please clarify the basis for interpreting the Delta ERA boundary as a relatively small circle.

2. Figure 1-7: Coca Area Estimated Soil Remediation Areas
   Please clarify the basis for interpreting the Coca ERA boundary as a relatively small circle.

3. Figure 2-41: Extent of Trichloroethene in Groundwater

   In addition to General Comments #2 and 3, please modify/clarify the yellow and blue arrows included on the figures.

4. 2.1.2 Field Mapping
   Page 2-4, 2nd paragraph
   "There was no field evidence of faulting or extensive fracturing along this feature, so it could not influence groundwater flow or COC migration. It is depicted on the geologic map as a dotted line to reflect this uncertainty."

   Corehole logs from C-15 indicate slickensides and fault gouge. This should be considered field evidence of the fault. Further the presence of a lineament and deep occurrence of contamination are consistent with a fault or fracture zone. Pre-development aerial photos from 1953 (Figures 3 & 4 from the U.S. EPA 1997 Aerial Photographic Analysis, Rockwell Rocketdyne, Santa Susana Field Laboratory [TS-PIC-9709912R]) show significant vegetation associated with the Delta fault lineament. The statement that "it could not influence groundwater flow or COC migration" is, at a minimum, not supported and should be removed. The amount of additional data and refinement needed will be dependent on the needs for the implementation of the selected groundwater remedy(ies).

5. 2.1.5.1 ND-113
   Page 2-5, 5th paragraph
   "Well ND-113 is located north of the Coca Skim Pond to the west of the Coca Test Stand. Large, open fractures occur at depths of about 86 feet, 199 feet, 205 to 210 feet, 310 feet, 330 to 332 feet, 454 to 456 feet, and 593 feet bgs. A plot of the fracture orientations (Figure 2-9) shows that the predominant fracture orientation strikes northeast with a dip of about 28 degrees to the northwest, which is similar to the measured bedding plane orientation, though there are other fracture orientations that have a southwesterly dip of about 75 degrees."

   This statement discounts that fractures between 205 and 210 have large open apertures and are steeply dipping. The statement is correct that the predominant (i.e. majority of) fracture orientation is consistent with bedding fractures, however, there are significant groupings of more steeply-dipping and open fractures. The Coca/Delta report should acknowledge and address these additional fracture sets and their potential effects on groundwater flow and contaminant transport.

6. 2.1.5.9 WS-11
   Page 2-2, 8th paragraph

   The Coca/Delta Report should point out that WS-11 does not have any identified fractures until a depth of 615 feet bgs. This large interval of corehole without a discontinuity is anomalous at the site and should be noted.

7. 2.2.4.2 Near-surface Groundwater

   The groundwater and potential surface discharge near the Delta Skim Pond and the R-2 Ponds needs further evaluation. Groundwater flow direction fluctuations at Delta Skim Pond provided some indications that the surface water contained in the R-2A Pond was recharging the nearby groundwater or, at times, groundwater may have been discharging to the R-2A Pond. Accordingly, groundwater elevations in the near-surface groundwater monitoring wells have been close to the elevations the surface water elevations in the R-2A. Since the groundwater beneath the Delta Skim Pond is contaminated, it is important the determine the potential for the groundwater to discharge to the surface.

8. 2.3.2.4 Groundwater Plume Mass Estimate

   Due to the complexities for groundwater flow and contaminant transport in porous fractured media (such as the Chatsworth Formation at SSFL), getting a reasonable estimate of the contaminant mass is difficult. The approach in the Coca/Delta report, which is limited to TCE, should be viewed as a rough calculation based on the simplified assumptions. For consideration in the remedy design and implementation, the GSU recommends that the estimates be viewed conservatively and up to an order of magnitude below the actual mass present.

Reviewed by: Jon Buckalew (Buck) King, P.G., C.HG.